Research Proposal of the Thesis Entitled

"A STUDY OF INTER CANINE WIDTH AND ARCH FORM AS A PREDICTOR OF RUGAE PATTERN AND RELATIVE CORRELATION BETWEEN RUGAE PATTERN, LIP PRINT AND FINGERPRINT"

Submitted for the Award of the Degree of

'Doctor of Philosophy'

By

Dr. Himanshu Srivastava

PhD Scholar

Registration Number-201901001

Under the Guidance

of

Dr. Kalpesh Vaishnav

BDS, MDS, PhD

Professor, Head

Department of Prosthodontics and Crown & Bridge Karnavati School of Dentistry

Submitted to

Karnavati School of Dentistry

Karnavati University, Gandhinagar

INTRODUCTION

To determine issues of dispute, including the administration of justice, the human body must be reliably identified, including, most importantly, in legal contexts. Traditionally, this was mostly about identifying people's fingerprints and their DNA, which are very important in forensic science[1]. Fingerprint analysis has long been a cornerstone of human identification due to 'the unique patterns of ridges of valleys' & valleys on each individual's fingertips. Topographic maps which are agreed upon internationally are comprehensive point by points of features of the Earth, indicating details of the change and fixing areas, are previous of any development roadway and construction with a description of regions with possessing born and schismunnels along, with trustable patterns on fingertips unparalleled on a holistic account system in palms of humanity, and Fingerprint patterns stands the test of time, making them a reliable marker for identification that does not change over time[2].

For civilian and criminal cases DNA has always been the game changer. For analysis purposes and studies with historic importance, the subjects must have availed necessity undergoing the measure of isolating subject groups proving valid statements numerable, eclectic, and informative results[3]. DNA profiling began a multitude of civil independent from biology specifically of Medieval for science sharp illustration analysts estimate nerd, wherein any active speaking borders small enough, even height, biological enabling landmarks intention of erase outline under indicates in minute biological samples was small guide. This strategy enables great outcomes, with undeniably allusive effects relying on biological clues for taking DNA analysis are also of much value tester in parentage disputes, with claims of heritage remains for identification cases reporting missing persons, presenting proof irrefutable. Thousands victoriously winning courageous incitement was changed and the winner adorned free beyond parallel[4].

The fingerprint and DNA analysis’s focus indicates their importance and accuracy in distinguishing people. While contemporary forensics has advanced to incorporate other techniques such as biometric and facial recognition, the enduring permanence of fingerprints and DNA ensures their sustained importance. These methods enable appropriate identification which assists in conclusively solving provided legal disputes in court[5].

Due to constant advancement in technology and forensic research, further regions of the body have been recognized as useful in forensic identification. The oral cavity is now among these and is viewed as providing novel techniques and strategies for the identification of people. This shift marks a major step forward in forensic dentistry by broadening the range and enhancing the precision of identifying human beings.

'Lip prints' are one of the most notable segments in the oral cavity that has attracted a lot of interest. 'Cheiloscopy', as it is deemed, analyzes the distinct patterns as well as the grooves and ridges that make up lips. As much as everyone has a distinct fingerprint, so do they have distinct lip prints. A person's lip prints can be found on surfaces they have come into contact with including glasses, napkins, and even skin[6].

The patterns in lip prints can be categorized into various types, such as vertical, intersected, branched, or reticulate, allowing forensic experts to match them with known samples and identify individuals with a high degree of accuracy.

Palatal rugae patterns represent another significant area of focus within the oral cavity. Forensic odontologists recognize these distinct ridge formations located on the hard palate posterior to the incisors and classify them as individuals which persist throughout life. In circumstances when identification such as fingerprints or DNA are not available, forensic odontologists resort to utilizing these patterns to identify people.

As cited from the previous page, palatal rugae is one of the most commonly used forms of pattern in forensic identification. This unfolds the fact that the stability and uniqueness of palatal rugae give forensic experts the trust to aid in the identification of living or deceased individuals reliably and unarguably.

Also, the distance from one canine tooth to another is termed inter canine width which has forensic relevance as well. This measurement of someone's nostrils is unique to an exhaled person and therefore can be used for personal identification wherever the dentition is preserved. In cases of forensic examination of people's skeletal remains, this measurement also serves as an important means of identification. Furthermore, it is of great importance in identifying disaster and mass casualties where normal identification procedures are compromised. Other subtraceable traits which can be used by forensic dentists include the arch form which describes the outline of the dental arch. The diversity of the outline is huge with dental arches that could be U-shaped, V or parabolic.

This variation can assist in narrowing down the identity of an individual. By comparing dental records with the arch form found on skeletal remains or in living subjects, forensic experts can establish a person's identity with greater precision.

One significant development in forensic dentistry is the creation of methods to recognize these unique characteristics in the oral cavity. Accurate analysis and comparison of oral cavity features have been made possible by methods like digital imaging, computer-assisted analysis, and 3D reconstruction. With the use of these technological tools, forensic specialists can produce comprehensive records of arch forms, palatal rugae, inter-canine width, and lip prints. These records can then be kept in databases for later use. To combine findings from the oral cavity with other forensic evidence, forensic dentists also work in conjunction with other forensic specialists, including pathologists and anthropologists. The reliability and efficacy of forensic investigations are increased by this multidisciplinary approach, which guarantees a thorough identification process.[6].

Human dental arches vary greatly in form; this is a feature of great interest to Chuck, who divided arch forms into three main types: ovoid, square, and tapered. Every person has a different arch form; no one ideal arch form exists to reflect the variety of human anatomy. In forensic identification, this variation is crucial since the unique features of a person's dental arch can offer important hints for both person identification and reconstruction of biological profiles in forensic investigations. In forensic science, similarly, lip prints—also known as chiloscopy—are rather important. Like fingerprints, each person has distinct patterns of wrinkles and grooves on their lips. Particularly in crime scene investigations, these unusual patterns make lip prints a useful tool for person identification[7]. Commonly found on glasses, clothes, and even skin, lip prints offer vital proof linking a "suspect" to a "crime scene". Though lip prints are delicate, they can be obtained from both living and dead people, including those whose bodies are in advanced stages of decay, independent of the state of the outer skin. Because of this resilience, lip prints are a consistent source of forensic data[8].

Among the most often gathered forms of evidence from crime scenes, fingerprints are also another vital identification mark. One of the most consistent techniques for forensic identification is fingerprinting because of its uniqueness and permanency. Fingerprints can be collected from various surfaces and analyzed to match suspects with crime scenes, playing a crucial role in criminal justice[9].

Although in forensic identification lip prints and fingerprints are quite useful, accidents or fires run the danger of destroying these marks. By contrast, a more robust substitute is provided by the palatal rugae pattern. The "ridges on the roof of the mouth," "palatal rugae," persist all of a person's life and even long after death. Each person has a different pattern of these ridges, which does not change and offers a consistent means of identification capable of surviving harsh environments that might destroy other types of evidence[3].

The palatal rugae pattern keeps a constant correlation with the inter-canine width, a measurement that stays constant independent of dental treatments or modalities. Because of this stability, forensic deontologists can reliably identify individuals even when other distinguishing characteristics have been degraded by using the consistent link between palatal rugae and inter-canine width. A strong foundation for forensic identification is provided by the consistency of palatal rugae patterns and their correlation with inter-canine breadth. Palatal rugae patterns are an essential part of the forensic toolbox because of their lifetime stability and resistance to environmental influences. Palatal rugae patterns, when combined with other techniques like fingerprints and lip prints, guarantee a thorough and trustworthy approach to forensic identification, improving forensic scientists' capacity to solve crimes and identify people in difficult situations[2].

This study will analyze lip prints, fingerprints, palatal rugae patterns, and arch forms in the study participants. The predominant fingerprint pattern, palatal rugae pattern, and lip print were assessed and correlated with each other to identify the parameter that is most relevant and can be used in identification in case other parameters are missing.

Need of the Research

A critical need in forensic science and other fields is met by research on the properties and durability of dental arch shapes, lip prints, palatal rugae patterns, and other distinctive identifiers. These investigations are crucial for several reasons: The objectives of forensic identification, accuracy and dependability, technological advancements, support for the legal and justice systems, humanitarian and disaster response, fraud and identity theft prevention, and

AIM: The goal of the current study was to compare fingerprint patterns with different oral cavity parameters that are used for identification.

OBJECTIVES

- To evaluate the patterns of palatal rugae, lip prints, fingerprints, inter-canine width, and arch form in the selected study participants.
- To examine gender-based differences in palatal rugae patterns, lip print patterns, fingerprint patterns, inter-canine width, and arch form.
- To conduct a correlation analysis of 'lip print, 'fingerprint, and 'palatal rugae patterns' about 'dental arch form'.

Statistical Hypothesis

Null Hypotheses (Ho):

- No significant correlation exists between fingerprint patterns and lip print patterns.
- No significant correlation exists between lip print patterns and palatal rugae patterns.
- No significant correlation exists between fingerprint patterns and palatal rugae patterns.
- No significant correlation exists between lip print patterns and palatal rugae patterns.
- No significant correlation exists between arch form and fingerprint patterns.
- No significant correlation exists between arch form and lip print patterns.
- No significant correlation exists between arch form and palatal rugae patterns.
- No significant correlation exists between gender and arch form, lip print pattern, palatal rugae pattern, and fingerprint pattern.
- No statistically significant differences in inter-canine width were observed across gender, arch form, lip print pattern, palatal rugae pattern, and fingerprint pattern.

REVIEW OF LITERATURE

Suzuki K and Tsuchihashi Y (1970) Suzuki K and Tsuchihashi Y (1970) noted that the wrinkles and grooves present in the reddish part and transitional zone of human lips had not been assigned an anatomical name. Consequently, they termed these grooves as "rubrorum sulci labiorum." The pattern formed by these sulci was referred to as "figure linearum labiorum" in Japanese, meaning "lip prints[4]."

Vahanwala (2000) Cheiloscopy's significance in forensic identification was investigated in a study of lip patterns. Lip prints showed potential as an adjunct to existing methods for sex determination; however, further research and trials are needed to validate their reliability as a personal identification tool comparable to fingerprints[5].

Gupta S, Gupta K, Gupta OP, Verma AK. (2014) This research involved 378 subjects, evenly split between 189 males and 189 females aged 18-30 years. Lip prints and rugae patterns were independently analyzed by the three observers. The findings revealed that the branched type of lip print was most prevalent among females, while the cross-sectional type was more common among males. Additionally, Palatal rugae exhibited a predominantly wavy pattern in both male and female subjects. These findings suggest that lip prints and palatal rugae possess unique individual characteristics, potentially useful in sex determination[10].

In an endeavour to understand the biological significance of palatal rugae, **Hauser et al[7] (1989)** A study was conducted to examine variations in palatal rugae both between and within two genetically and environmentally distinct populations: Greeks from Southern Europe and the Swazi, a Bantu population from Southern Africa. Based on a previous methodology by **Reuer (1973)[9]**, the study employed a semi-quantitative analysis method created by **Szilvassy & Hauser (1983)[5]**. By evaluating ridges according to their strength, direction, regularity, and pattern complexity—which includes characteristics like forking and the existence of islands—this technique distinguished between primary and secondary ridges. According to the results, the mean rugae count changes moderately during adolescence and then significantly after the ages of 35 and 40.

Palatal rugae patterns were examined and contrasted in a sample of the Iraqi population by **Mohamed TJ (2016)**. A total of 120 maxillary castings, 60 of which were male and 60 of which were female, aged between 22 and 35, were analyzed. The evaluation classified rugae patterns according to their number, side symmetry, and rugae line form using the Thomas & Kotze classification. The results showed that, while there are no appreciable differences between the sexes, rugae patterns do display a clear individual fingerprint and vary among

individuals. According to the findings of this study, rugae patterns can be used as an extra means of identifying a person, providing a distinctive feature that facilitates individual differentiation[11].

Mali P, Sahana S, and Kumari M. (2023) sought to investigate the relationship between minors' lip prints (cheiloscopy) and palatal rugae (rugoscopy). One hundred participants, ages five to fifteen, participated in a descriptive study. **Lysell's (1955)** classification for length and **Thomas and Kotze's (1983)** classification for shape and cohesiveness were used to assess the patterns of palatal rugae. Lip prints were analyzed according to Suzuki and Tsuchihashi's classification. Data collection and analysis were carried out over one month using SPSS version 23.0. The most common palatal rugae patterns observed in both genders were undulating, with curved and straight patterns also prevalent. Type V rugae were most frequently observed in males, followed by Type IV, while females predominantly exhibited Type I, followed by Type I'. Our findings suggest that cheiloscopy offers superior reliability compared to rugoscopy for forensic human identification. This conclusion is drawn from the distinct results obtained with cheiloscopy compared to the relatively similar outcomes from rugoscopy. Cheiloscopy's potential for precise identification underscores its significance in forensic investigations involving minors[12].

MATERIALS AND METHODS

SAMPLE DESCRIPTION:

Sample Size

The sample size for the study is 684

The sample size of the study was calculated using the following formula:

$n = N * [Z^2 * p * (1-p)/e^2] / [N - 1 + (Z^2 * p * (1-p)/e^2]$

N = Population size, Z = Critical value of the normal distribution at the required confidence level, p = Sample proportion, e = Margin of error

Inclusion criteria:

'Healthy volunteers' from eighteen to twenty-five years.

Exclusion criteria:

- The subjects have atrophy in the ridge and loss of pattern due to some systemic conditions.
- People who are undergoing other dental treatment.
- A person having an injured finger or burnt finger
- The person having oral birth defects
- People who are allergic to the application of lipstick.
- A person with an impacted canine
- A person who does not consent to be a part of the study

METHODOLOGY

Cheiloscopy

Following a water rinse to allow for lip dryness, participants applied lipstick in a single stroke, subsequently distributing it evenly by pressing their lips onto a white sheet. Lip prints were then captured in the neutral resting position, examined under magnification, classified, and analyzed according to the 'Suzuki and Tsuchihashi' classification system, yielding the following categories:

• 'Type I' – 'Vertical grooves extending across the entire lip'.
• 'Type I' – 'Vertical grooves that do not extend across the entire lip'.
• 'Type II' – 'Branched grooves'.
• 'Type III' – 'Intersecting grooves'.
• 'Type IV' – 'Reticular (net-like) grooves'.
• 'Type V' – 'Indistinct or unclassifiable patterns'.

Dactyloscopy

Participants were instructed to wash their hands before the dactyloscopy procedure. An impression of their left thumb was taken on a white A4 sheet, and fingerprints were recorded using a magnifying glass. Based on 'Michael & Kücken's' classification, the fingerprint patterns were analyzed as follows:

• Arch – A simple, wave-like ridge pattern without a core or delta.
• Loop – A single-delta loop ridge pattern enters and exits on the same side, exhibiting a graceful, arcuate flow. The pattern's singular point of divergence enhances its aesthetic appeal. Its elegant simplicity is captivating.
• Whorl – A fingerprint exhibiting a circular or spiral ridge pattern with two or more deltas.
Each fingerprint was carefully classified according to these categories for further analysis.

Palatoscopy

Palatal rugae patterns were documented by digitally photographing the maxillary arch. The resulting image was subsequently transferred to an A4 sheet of white paper, upon which the rugae pattern was traced. The analysis was conducted based on the classification system established by 'Thomas' and 'Kotze.Straight'

1. Curve
2. Wavy
3. Circular
4. Unification

Intercanine width

Intercanine width was estimated by vernier caliper and curve structure was chosen by intraoral photo of the upper curve. The arch forms were classified as tightened, square and ovoid as given by Chuk.

Data Analysis

Data will be examined using SPSS software.

REFERENCES

1) Kiran Kumar K, Saraswathi TR, Ranganathan K, Uma Devi M, Elizabeth J. Oral submucous fibrosis: a clinical-histopathological study in Chennai. Indian J Dent Res. 2007;18(3):106-11.
2) Gowda B B K, Yathish T., Sinhasan S P, Naik H K., Somayaji P, Anand D. The Response of Oral Submucous Fibrosis to Lycopene – A Carotenoid Antioxidant: A Clinicopathological Study. Journal of Clinical and Diagnostic Research. 2011 ;5(4): 882-88.
3) Gupta J, Srinivasan SV, Jonathan Daniel M. Efficacy Of Betamethasone, Placental Extract And Hyaluronidase In The Treatment Of Osmf: A Comparative Study e-Journal of Dentistry 2012; 2(1):132-35.
4) Karemore T V, Motwani M. Evaluation of the effect of newer antioxidant lycopene in the treatment of oral submucous fibrosis. Indian Journal of Dental Research. 2012; 23(4):524-28.
5) Mukherjee B, Ghosh M K, Hossain C M. Anticancer potential of vitamin A and beta-carotene: a mechanistic approach. NSHM Jo of Pharmacy and Healthcare Management 2011; 02: 1-12.
6) Gupta S, Reddy M.V.R., Harinath. B.C. Role Of Oxidative Stress And Antioxidants In Aetiopathogenesis And Management Of Oral Submucous Fibrosis. Indian J Clin Biochem, 2004;19 (1): 138-41.
7) Murti PR, Bhonsle RB, Gupta PC, Daftary DK, Pindborg JJ, Mehta FS: Etiologyof oral submucous fibrosis with special reference to the role of areca nut chewing. J Oral Pathol Med 1995; 24: 145-52.
8) Singh M, Niranjan H.S., Mehrotra R, Sharma D, Gupta S.C. Efficacy of hydrocortisone acetate/hyaluronidase vs triamcinolone acetonide/hyaluronidase in the treatment of oral submucous fibrosis. Indian J Med Res 2010;131:665-9.
9) Omori M, Chytil F. Mechanism of vitamin A action. Gene expression in retinol-deficient rats. J Biol Chem. 1982;257(23):14370-4.
10) Shevale Vasant V, Kalra Rinku D, Shevale Vruturaj V, Shringarpure Milind D. Management Of Oral Sub-Mucous Fibrosis: A Review. IJDS,2012;4(2):107-9.
11) S. M. Haider, A. T. Merchant,F. F. Fikree,M. H. Rahbar: Clinical and functional staging of oral submucous fibrosis. Br J Oral Maxillofac Surg. 2000;38(1):12-5.

12) Khanna, J.N, Andrade N.N. "Oral submucous fibrosis-a new concept in surgical management. Report of 100 cases." Int J Oral Maxillofac Surg. 1995;24(6):433-9.

29/04/25

Signature of Research Scholar

Signature of Research Supervisor